PREPRODUCTION INITIATIVE-NELP
AIRCRAFT DEICING AND AFFF WASTEWATER TREATMENT TEST PLAN

SITE: NAS WHIDBEY ISLAND

1.0 OBJECTIVE

This test plan describes the data collection procedure for evaluating an anaerobic fluidized bed reactor (AFBR) in an operational environment. The data will be used to determine the efficiency, effectiveness, and overall success of this system in the treatment of deicing fluid and aqueous film forming foam (AFFF) wastewater.

2.0 DESCRIPTION

Department of Defense (DOD) facilities are required to properly manage a variety of high-strength industrial wastewaters. Two such wastewaters of concern to Naval Air Station Whidbey Island (NASWI) are runoff from aircraft deicing operations and runoff from firefighting system tests and operations. The runoff from deicing operations is highly seasonal in nature. Deicing wastewater contains propylene glycol and other contaminants that can have a chemical oxygen demand (COD) 3,000 times that of municipal wastewater. AFFF wastewater is less seasonal and is largely the result of frequent, mandatory firefighting system tests, training, false alarms that activate automatic dispersion systems, and spills. AFFF wastewater can have a COD 50 times that of municipal wastewater and has a tendency to cause foaming problems in treatment systems.

Municipal wastewater treatment plants (WWTPs) often reject glycol deicing and AFFF wastewaters because of the system upsets that can result from shock loading and foaming. The NASWI Navy owned treatment works (NOTW) treats a daily average of 435,000 gallons of wastewater with an average influent biological oxygen demand (BOD) of 188mg/L and average influent total suspended solids (TSS) of 134 mg/L. Due to the facility's relatively low flow and the need to comply with the base's discharge permit, the NOTW cannot accept either deicing or AFFF wastewater. Consequently, the two wastestreams are currently collected and shipped offsite for treatment and disposal.

AFBR technology has been proven to successfully treat wastes with high concentrations of organic materials (as indicated by high BOD or COD levels). It is currently being used in a civilian setting to treat wastewater similar to the NASWI deicing waste. The AFBR supports the growth of microorganisms on a hydraulically fluidized bed of granular activated carbon (GAC). The bioreactor promotes the growth of microorganisms that quickly encapsulate the GAC and form a layer of dense biomass with a large surface area. The large surface area and high biomass concentration achieved in the fluidized bed result in high percentage removal rates. In addition, the use of GAC allows excess organic waste to be adsorbed and makes the system less susceptible to shock loadings.

Wastewater treatment is accomplished in a multistage process that begins by mixing the wastewater with a nutrient feed and chemicals to control pH and injecting the mixture into the bottom of the AFBR column. As the wastewater passes upward through the reactor, it comes into contact with the suspended biomass. The biomass then metabolizes the organic material within the wastewater and produces biogas (primarily methane, carbon dioxide, nitrogen) and additional biomass. To stabilize flow rates and organic loading, a portion of the treated effluent is mixed with the incoming flow and recycled through the AFBR system. The remaining treated water is then discharged to a WWTP. The generated biogas, which has poor solubility in water, is separated from the wastestream and vented out the top of the reactor. During this demonstration, an air discharge permit was not required. The methane portion of the generated biogas could be scrubbed of impurities and used as an alternative energy source under normal operations.

An AFBR system from EFX Systems, Inc. was selected for prototyping at NASWI. The main goal of the test is to determine whether the AFBR can cost effectively produce effluent with reduced BOD and TSS concentrations, thus allowing the treated wastewater to be discharged to the NOTW without effect. It is expected that by using the AFBR system to pretreat deicing and AFFF wastewaters, NASWI will be able to safely discharge the treated wastewater to its NOTW. This would eliminate the costs and potential for offsite spills associated with the current disposal method.

3.0 TEST PLAN

This test plan will be used to evaluate the effectiveness of the EFX Systems Inc. AFBR system. Quantitative and qualitative data will be collected and used to evaluate the system's ability to reduce waste disposal costs, produce an effluent of quality suitable for direct discharge into the base NOTW, and integrate into existing site operations. Because the unit being tested is a pilot-scale system, the test also will be used to assess the practicality of implementing a full-scale AFBR at NASWI and similar locations.

3.1 Approach

One EFX Systems Inc. AFBR will be evaluated during this test period. Once the AFBR is installed, the loading rate will be ramped up until a maximum achievable treatment rate is determined. The influent and recycle flow rates will then be varied until the maximum removal efficiency is determined for a given influent and effluent quality. Hydraulic retention times (HRTs) will also be varied to measure system efficiency for several effluent criteria.

Both influent and effluent samples will be analyzed for a variety of water quality criteria (including glycol and AFFF concentrations) to assess reactor health and performance. Nutrient and pH control chemical additions will be recorded to determine the projected operational costs of a full-scale AFBR system. Biogas production volumes and composition will be monitored to determine what economic benefit can be gained from the treatment and use of the methane and to assess reactor health.

Data will be collected for three months, recorded, and reported in accordance with this plan. During the test period, the necessary quantitative and qualitative data will be acquired by completing the Operator's Daily Checklist/Logs and the Operations and Repair/Maintenance Data Sheet. Completed invoices will also be reviewed to help determine operating costs. Additional system-related expenses and data (e.g., labor requirements, power requirements, test chemicals, system chemicals, laboratory testing, consumables, maintenance requirements) will be supplied separately by Space and Naval Warfare System Center (SPAWARSYSCEN) personnel. In addition, SPAWARSYSCEN and NASWI personnel will be responsible for supplying data (e.g., monthly wastewater shipping invoices) to be used in determining current offsite wastewater disposal costs.

3.2 Instructions for Completing the Operations and Repair/Maintenance Data Sheet

The Operations and Repair/Maintenance Data Sheet will be used to determine all other AFBR operating costs as well as to document any maintenance or other reliability issues. In addition, this form will be used to gather any feedback regarding the system's ease of operation.

- **Operator Name:** Enter the name of the person completing the data sheet.
- **Week of:** Record the beginning and end dates of the current week.
- **Operations Labor Hours:** For each day of the week, enter the total number of hours spent checking and/or making adjustments to the AFBR system. Include any time spent mixing nutrient mixtures or replenishing pH control chemicals. Also include the time spent filling out the daily checklist.
- **Sampling/Testing Labor Hours:** For each day of the week, enter the total number of hours spent collecting samples from the AFBR system, running required tests on the collected samples, or packing samples for shipment to an offsite lab for analysis.
- **Repair Labor Hours:** For each day of the week, enter the total number of hours spent actively repairing the AFBR system. Include the time spent identifying and removing the defective/malfunctioning part(s) and the time spent obtaining and installing the replacement part(s). Do not include time spent waiting for the arrival of replacement parts.
- **Treatment System Downtime:** For each day, enter the number of hours that the AFBR system was offline.
- **Lab Sample IDs:** List the ID numbers of all samples sent to the lab for offsite analysis during the week. Include the date each sample was sent. Do not include samples that were analyzed at NASWI.

- **Reason for Downtime:** Enter the reason for any system downtime that occurred during the week. Include the date(s) that corresponds to each reason.
- **Repairs/Maintenance Needed:** Describe any repairs or preventative maintenance performed during the week.
- **Replacement Parts Installed:** List any replacement parts installed during the week. Do not include replacement parts that have been requested but not yet installed.
- **Comments/Feedback on System Operation:** Write any comments concerning the system's operation or ease of use. Include suggestions for improving the operation of the system or the usability of the controls or gauges.

3.3 Operator's Daily Checklist/Log

The Operator's Daily Checklist/Log will be completed by the system operator(s) and used daily to assess the health and performance of the reactor. Data collected on the Operator's Daily Checklist/Log will also be used to determine the cost of system implementation and operation. It is very important that this form be completed daily in accordance with the instructions provided during operator training. Instructions for completing the Operator's Daily Checklist/Log are not included in this test plan since the checklist/log is self-explanatory.

4.0 REPORTING

The data sheets are a concise method of data collection. The sheets should be completed daily and whenever maintenance or repairs are necessary. During the test period, periodic status reports on the evaluation will be submitted to NAWCADLKE. The final report will include information on the system's overall performance, cost-effectiveness, ability to interface with site operations, and ability to produce an effluent that is of suitable quality for direct discharge into the NASWI NOTW.

4.1 Deliverables

SPAWARSYSCEN personnel must ensure that the following documentation is submitted *weekly* during the test period.

- Operations and Repair/Maintenance Data Sheet (if applicable)
- Operator’s Daily Checklist/Log
- Invoices for all system related materials (if applicable)

One copy of all completed data sheets, checklists, and invoices should be faxed.

OPERATIONS AND REPAIR/MAINTENANCE DATA SHEET

Operator name: ______________________________ Week of: _______________________

Parameter	Frequency	Units	Sat	Sun	Mon	Tue	Wed	Thu	Fri
Operations labor hours	daily	hours							
Sampling/testing labor hours	daily	hours							
Repair labor hours	daily	hours							
Treatment system downtime (specify reason below)	daily	hours							

Lab sample ID no.: ____

Reason for downtime: ____

Repairs/maintenance needed: ____

Replacement parts needed: ____

Replacement parts installed: ____

Comments/feedback on system operation: ____

OPERATOR'S DAILY CHECKLIST/LOG—NASWI FBR

Date:_______________ **Day number:_______________** **Operator:________________________**

Time:_______________ **Period:____________________** **Ambient Temp:___________________**

Touch Screen (touch screen to view)	Expected Range/Units	Reading	Control Panel	Expected Setting	Reading
Fluidization flow	52-57 gpm		Air compressor	AUTO	
Feed flow	0 gpm		Fluidization pump select	1	
Influent pH	6-8 su		Fluidization pump	AUTO	
Effluent pH	6.5-7.5 su		Fluidization valve	AUTO	
Reactor inlet pressure	7-8 psi		Oxygen feed valve	CLOSE	
Reactor temperature	90-95°F		Bubble trap purge valve	CLOSE	
CH_4 concentration	50-100%		Nutrient pump	AUTO	
CO_2 concentration	0-50%		Feed pump	OFF	
			Temp control	AUTO	
			Substrate pump	AUTO	
			Feed valve	AUTO	
			pH control select	INF	
			Foam spray pump	ON	
			pH pump	AUTO	
			Anti-foam pump	AUTO	

Skid Readings	Location	Units	Range	Reading			
Wet test meter readings	Use flashlight						
3000 L dial reading	WTGM 1st dial	L	100-3000		(x100) =		
300 L dial reading	WTGM 2nd dial	L	10-300		(x10) =		
30 L dial reading	WTGM 3rd dial	L	1-30		(x1) =		
3 L dial reading	WTGM large dial	L	0-3				
10-minute average flow rate	WTGM 3rd dial	L/10 min	1-3	300 L Dial			30 L Dial
	Stop watch		Start		(x 10) =		
			Stop		(x 10) =		
			Difference		(x 10) =		
1 minute average flow rate		L/min					
Drain drip traps after reading meters	Before WTM and before infrared gas meter		Red valve handles				
ADF feed system							
Percent stroke length	Dial on pump face	%	20-100				
Percent stroke rate	Dial on pump face	%	10-100				
Glycol feed tank level	Marking on tank	gallons	50-500				
AFFF FEED SYSTEM							
Percent stroke length	Dial on pump face	%	20-100				
Percent stroke rate	Dial on pump face	%	10-100				
AFFF feed tank level	?	gallons	?				
NUTRIENT FEED SYSTEM							
Percent stroke length	Dial on pump face	%	30-100				
Percent stroke rate	Dial on pump face	%	10-100				
Nutrient feed tank level	Dipstick - **STIR**	gallons	5-25				
CAUSTIC FEED SYSTEM							
Percent stroke length	Dial on pump face	%	30-100				
Percent stroke rate	Digital display	%	varies				
Feed tank level below top	Flashlight	in	0-35				
REACTOR PIPING							
Fluidization pump discharge pressure	Gauge after pump	psi	15-25				
Control valve pressure	Gauge after control valve	psi	6-8				
CARBON BED HEIGHT							
Depth to bed	From top of flange	ft-in	(subtract 20' from tape)				
Carbon bed height	12' 3" - depth to bed	ft-in					
VACUUM BREAK CHECK	top of reactor		break intact? Yes/no				
AIR COMPRESSOR CHECK							
Turn OFF - check oil level - turn AUTO	WEEKLY CHECK	dipstick	within 2 lines				
Tank pressure	Gauge on tank	psig	90-150				
pH probe calibration							
Influent probe checked?	WEEKLY CHECK	YES/NO					
Effluent probe checked?	WEEKLY CHECK	YES/NO					
Effluent COD drawn 0930	Daily sample	mg/L					

Notes on reverse side? Yes/no